EXPERIENCES IN PRIORITY SETTING: LESSONS FOR ENVIRONMENTAL RESEARCH IN LATIN AMERICA AND THE CARIBBEAN [1]

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1. Introduction

Overall the recommendations in Agenda 21 called forth for new financial resources to tackle the most urgent problems of environment and development are of the order of 125 billion US dollars. To put this in the context of the International Development Research Centre (IDRC), the resources available to IDRC amount to less than 0.1% of the resources called for in Agenda 21, while as all the DFI's together provides resources (in the form of loans) in the order of one third the amount called for (Rath, 1994).

Donor agencies and policy makers are continuously faced with the resource allocation issue. In the environmental field a series of dimensions make such decisions particularly difficult: problems are complex, dynamic, frequently with transboundary or even global implications, markets are imperfect or non-existent. This paper looks at methodological approaches to deal with the resource allocation issue in the context of research funding, then looks at methods used in making allocations in the environmental field, to then analyze the outcomes of some real environmental prioritization processes undertaken in or for the Latin America and the Caribbean (LAC) region and for some specific subsets of issues. Conclusions are drawn from the above for agencies facing the need to make allocation decisions in this complex real life setting.

2. Approaches used to set research priorities issues

The base for resource allocation in economic theory is quite simple. Resource allocation is optimized if the marginal productivity of one resource unit is equal to all alternative uses. Research priority setting from an economist's perspective is just another case of investment analysis. The simple principle of equating marginal productivity across alternative investment choices is nevertheless not that easy to implement, particularly for research investments. Reasons are:

a) difficulties in foreseeing the society wide impacts of research results;
b) difficulties in valuing those future benefits; and
c) difficulties in assessing probabilities of success of the research process.

The need to make research priority decisions has led to a range of approaches to circumvent some of the above problems. Approaches vary in their data requirements and their scientific rigor when assessed from an economic theory perspective. They will be described briefly as there is a wide literature covering these approaches. (e.g. Norton and Davis, 1981).

a) Peer reviews:
They are the basic instrument of quality control in the Western research system. Chubin and Hackett (1990) present a good review of the approach. As Alston et al (1994) state, this methodology is more appropriate for prioritization among individual project proposals than among broad programs. Socio-economic methods should be applied there (see below). Peer reviews can contribute to the definition of technical parameters for economic surplus models.

b) Delphi analysis:
This approach constitutes an improvement of peer reviews. Evaluators are confronted with the results of prior rounds and are given a chance to explain their rating and or to change assessments. Over two to three iterations assessments tend to converge to a consensus. This approach is used particularly in industrial development for technology foresight.

c) Congruence analysis:
This approach looks at the research funding allocation problem by comparing the share of output value of individual commodities or related problems vis a vis the share of research expenditure on these commodities or problems. The underlying assumption is that the productivity per money unit invested in each alternative is similar. Thus additional information on success probabilities, etc is not built into the decision process. The technique is inherently conservative as no funds are allocated to emerging fields or for that matter environmental problems.

In the agricultural sector the effort of CGIAR to use this approach to allocate resources to international agricultural research is particularly noteworthy (TAC,CGIAR, 1992). In this case the congruence analysis was modified by incorporating weightings to reflect focus on poverty alleviation. Thus the

model became a scoring model (see next section), in which values of production were an important dimension.

d) Economic surplus models:
These models are based on welfare economics theory. They require explicit statement of the supply shifts to be induced by research. These supply shifts cause changes in prices within a comparative static framework. Thus these models do not explicitly take into account second and further order impacts of research in the economy. They are able to predict equity dimensions of first order effect of technical change and are thus frequently used in policy analysis (Janssen, undated). They are therefore particularly attractive to deal with commodity-based research, where impacts can be directly traced to specific markets and where supply and demand parameters are relatively well-known, given the commodity nature of these internationally traded goods. A recent extension of these models has been to explicitly deal with research externalities (spill-overs) across regions, a dimension of particular interest to the CGIAR, given the international public goods research the system's research investment is generating.

e) Scoring models:
Scoring models are approaches to combine quantitative and qualitative data in a framework which attempts to replace complete economic surplus models by proxies. In the agricultural case values of crop production are frequently used as proxies for welfare gains, share of a crop produced by small farmers as a proxy for equity considerations. Other criteria such as probability of success of the research investment, estimated number of scientist person years of investment required, etc. are defined for each of the alternative research investment options being considered. This process is frequently undertaken using peer review/Delphi exercises to provide consensus estimates. The criteria for each project are then aggregated to some indicator of project merit. Frequently weightings are introduced to more precisely reflect the relative importance of individual objectives of the institution making the allocation decisions. An interesting example of the application of this technique is the priority setting exercise undertaken by the International Potato Center (Collion and Gregory, 1993). As Alston et al 1994, indicate the ease of implementation is attained at a certain risk in

terms of alternative outcomes depending on the way the information is presented (e.g. absolute or relative terms, units of measurement). Frequently more than one indicator is used as a proxy for the same dimension e.g. percentage of crops in the diet of the poor and percentage of the crops grown by small farmers as indicators equity leading to "double counting" and increased weight given to that factor. In spite of criticisms, particularly from economists, scoring models are widely used because of their flexibility to incorporate dimensions for which "hard, quantitative" data are difficult to obtain. Furthermore the approach is intuitively understandable and can thus be used by general scientists not specialized in priority setting methods. This feature enhances "buy in" from stakeholders.

A good synthesis of the state of the arts in research evaluation and planning is given by the Office of Technology Assessment OTA (1986):

> "In summary, OTA finds that the metaphor of research funding as an investment, while valid conceptually, does not provide a useful practical guide to improving federal research decision making. The factors that need to be taken into account in research planning, budgeting, resource allocation, and evaluation are too complex and subjective: the payoffs too diverse and incommensurable; and the institutional barriers too formidable to allow quantitative models to take the place of mature, informed judgement.
>
> Bibliometric and other science indicators can be of some assistance, especially in research program evaluation, and should be used more widely. However, they are extremely limited in their applicability to interfield comparisons and future planning. The research planning and budgeting experience in some U.S.corporations and R&D forecasting efforts in Japan suggest a need to improve communications between the parties that carry out and utilize research. Also, to assure that a wide range of stakeholders, points of view, and sources of information are taken into account in formulating R&D plans and budgets,"

Along the same vein, Averch (1994) concludes his recent review stating that

> "current economic approaches give rough snapshots of how the large R&D aggregates affect entire firms, industries, or economies. These snapshots are useful for the highest level of decision making about R&D."

But both methodological issues and costs of information gathering limit the usefulness at lower levels of aggregation. Kostoff (1994) comes to a similar assessment of the applicability of cost-benefit analyses for the evaluation of basic research.

The conclusion of this review is that agricultural research is rather the exception than the rule in being amenable to economic ex-ante and ex-post evaluation. This is clearly related to:

a) the type of research: generally rather applied and thus clearly linkable to a commodity and thus to a market impact, and

b) the type of commodity affected: large transparent markets, homogeneous goods produced in an atomistic market structure, thus making assessment of impact in terms of prices and quantities easy.

It is clear that these attributes are quite different from the ones of environmental research (resource rather than commodity oriented, impacts with substantial valuation problems, system-wide impacts of research, etc).

3. Methodologies used in priorizing environmental investments

This section reviews approaches chosen to rank environmental problems/potentials. The perspective goes beyond research looking at all sorts of interventions.

a) Delphi analysis of Chile's environment

In the late eighties the Department of Ecology of the Catholic University of Chile conducted a Delphi exercise to identify and rank environmental problems country-

wide (Hajek et al, 1990). USAID supported this project. For each of the 13 regions of the country a panel of experts was appointed including persons from the planning agencies of the local government, independent professionals, producer organizations, academia, community representatives, politicians, communication media representatives, other outstanding personalities.

Each panel member was asked to list the main environmental problems of his region. The total listing of problems was consolidated and grouped into categories of problems.

Panel members were then asked to rank problems on a scale of 1 to 5 in terms of their importance and in terms of feasibility of control (0 being the lowest value). Average values were then computed for each score and these values were submitted again to the panel. Members could then reassess their initial judgement. Substantial departures from the central values were explained. These steps were undertaken iteratively until reasonable consensus was reached. Environmental problems were additionally mapped by the regional panels.

This exercise was later updated through a new round of regional seminars (Espinoza et al, 1994). A database was developed with further information of the sector of the economy most directly involved, the type of problem (pollution, natural resource degradation, human environment degradation) and a more detailed classification by resource or sector involved.

This exercise identified 1288 environmental problems in Chile. The fact that separate rankings by importance and by potential for control were elicited does not allow overall rankings related to the efficiency of allocating resources to the solution of problems. The approach is clearly more valuable in describing problems than in providing guidelines for action. As stated by the authors, the development and choice of problem solving strategies is not addressed by this effort. The extreme degree of disagregation is very valuable for local level intervention but is less so for national policy design.

b) Comparative risk assessment

This approach was developed by the US Environmental Protection Agency (EPA) to set priorities for environmental interventions at the State level. The approach has also been applied internationally. The comprehensive description of the approach (EPA, 1993) mentions applications in Bangkok, Thailand; Quito, Ecuador; and Tetuen, Morocco. EPA staff indicated that the approach has been used recently in Mexico and El Salvador (Martin, Debora: personal communication).

The approach is based on:

- Broad participation of wide range of stakeholders, supported by environmental "experts" feeding information into the decision making committees.

- Three types of risks are considered: human health risks, ecological risks and risks to the quality of life. Human health risks involve actual, estimated or anticipated cases of human disease or injury caused by environmental problems. Ecological risks are damages to the structure and function of natural ecosystems as well as to their biotic and abiotic components, e.g. fragmentation or loss of wildlife habitat, physical landscape modification and degradation. Risks to the quality of life relate to negative economic and social impacts of environmental pollution. Examples are the cost of replacing or treating contaminated water supplies.

- Risks considered are "residual" risks, risks present beyond what is being done presently to handle them, i.e. the approach is a marginal analysis of different options.

- Development of list of problem areas. Several approaches are suggested such as: by programmatic lines, by source, by pollutant or stressor, by affected resource, by geographic area, by economic sector.

- Ranking of risks is based on negotiated consensus building, voting or development of scoring procedures. Individual rankings are produced for the three types of risks described above. In some projects rankings by type of risk are consolidated into one prioritized list.

- Risk management strategies are developed for the problem areas defined . They are related to environmental goals and appropriate strategies selected in an iterative process. These are then recommended for implementation and results are monitored.

The approach is clearly related to above-described scoring models. No formal attempt is suggested to apply economic surplus measures to quantify magnitude of impacts. Emphasis is on utilizing existing information and collective judgements for making decisions and to do so in a way which will be conducive to political support to enhance the probability of success.

Minard and Jones (1933) from the The Northeast Center for Comparative Risk (NCCR) made a very thorough and thought provoking review of six state level comparative risk studies undertaken in the US. The review clearly documented the value of the thorough analysis of environmental problems and the exercise of ranking them. It proved difficult to develop priorities for action and to derive them consistently from those identified risks. As stated by the reviewers, magnitude of the risk does not necessarily translate into priority for action at the decision level for which actions are being planned.

> "The projects show that producing recommendations is relatively easy, although getting anyone to implement them is another story. The projects suggest that the comparative risk process have so far failed to devote enough time to analyzing and ranking risk reduction strategies. The rigor that goes into understanding problems has too quickly been abandoned when the projects shifted into more political territory" (Minard and Jones, op. cited, p.5.)

4. The bottom line: environmental priorities for the LAC region as seen by different agencies/authors

The previous section has shown the difficulties in producing clear rankings of environmental problems. The search for examples of actual environmental priorities revealed that these exercises are still rare and tend to result into long lists of problems grouped in few categories (of highest priority, very high priority and high

priority). In this section the outcomes of selected prioritization exercises are presented.

a) Aggregate regional prioritization exercises

IDB/UNDP (1991?) led a regional initiative to produce the document "Our Own Agenda" to present a regional perspective on environment and development at the Rio UNCED conference. This report produced by a group of regional experts presents an agenda classified into regional themes, international themes and global themes. The priority issues were ranked in declining order of severity and importance from an environmental point of view.

The regional issues are:

* Land use
* The environment in human settlements
* Water resources
* Ecosystems and biological patrimony
* Forest resources
* Sea and shoreline resources
* Energy
* Mineral resources (non-energy)
* Industry

The main international issues are:

* Shared river basins and ecosystems
* Acid rains
* The destination of toxic wastes
* Conventional wars
* Ecological security

The main global themes are:

* Nuclear risk
* Global warming
* Drugs
* Loss of biodiversity
* Destruction of the ozone layer

* Contamination and exploitation of ocean resources
* Use of resources of the Antarctic
* Use of outer space

It is not obvious whether the latter two sets of issues have also been ranked by importance. It is certainly interesting to note that the highest priority among the regional themes is allocated by land use followed by the environment in human settlements. On the other hand other "brown" issues related to industry, mining, energy are ranked rather low in the list.

USAID's environmental strategy for Latin America and the Caribbean (US AID, 1993) defines five areas for strategic action:

* Conservation of tropical forests and other habitats for biological diversity

* Sustainable agricultural practices

* Improved management and protection of water and coastal resources

* Promotion of environmentally sound energy production and use

* Reduction of urban and industrial pollution

It is interesting to note the divergencies between the two regional priority setting exercises. From USAID's perspective green issues rank substantially higher than from the IDB/UNDP perspective. This difference may be related to different country weightings. USAID is mainly involved in poorer countries with a more rurally based economy and a lower degree of urbanization, vis a vis the average of the region, which is reflected in the regional document. Furthermore a heavier weighting of green issues in the USAID agenda is consistent with the stated global environmental priorities for USAID: global climatic change and conservation of biodiversity.

b) Biodiversity conservation prioritization exercises

As stated in the previous section biodiversity conservation is seen as a high priority global environmental issue. Latin America is seen as a particularly important region for these global efforts given its high biodiversity and relatively lower degree of intervention related to population density and degree of urbanization. Two interlinked approaches to conservation priority setting for the LAC region will be described briefly.

The World Bank and the World Wildlife Fund developed a biogeographic approach to setting conservation priorities (Dinerstein et al. 1995). They classify the region into five major ecosystem types (METs), 11 major habitat types (MHTs) and 191 ecoregions. They use two sets of criteria to rank the priority for the ecoregions: conservation status and biological distinctiveness. The conservation status classification is based on the following criteria: total loss of original habitat, number and size of blocks of intact habitat, rate of habitat conversion, degree of fragmentation or degradation, and degree of protection. The biological distinctiveness of an ecoregion is assessed within its major habitat type. Thirty-four ecoregions in Latin America and the Caribbean were considered globally outstanding.

Ecoregions of highest conservation importance were identified by crossing information on conservation status and biological distinctiveness. Fifty-five out of 178 ecoregions (excluding mangrove ecosystems) were designated as of highest priority at the regional scale.

They include:

24 ecoregions in tropical moist broadleaf forests;
5 in tropical dry broadleaf forests,
2 in temperate forests,
5 in tropical and subtropical coniferous forests,
2 in grasslands, savannas and shrublands,
4 in flooded grasslands,
8 in montane grasslands,
2 in Mediterranean scrub,
2 in deserts and xeric shrubland, and
2 in restingas.

The study does not address social, political and economic factors which, the authors argue, are more fluid than the biological variables and should be applied in intra region analyses.

USAID sponsored a similar study by the Biodiversity Support Program (1995) which developed priorities for investing in biodiversity conservation in Latin America and the Caribbean. This was basically a Delphi exercise based on data assembled for specific aspects. Three dimensions were addressed a) biological importance b) conservation threat and opportunity and c) policy/institutional feasibility and human utility. The analysis was based on biologically and ecologically distinct geographic units called regional habitat units, largely based on the work done by WWF as part of the above described WB/WWF study. Table 1 presents the priority rankings produced by the workshop. A major finding of these studies is the fact that temperate forest and dry regions have regionally outstanding biological value and have been not received significant attention in the past. This contrasts with the conventional wisdom of the urgency for conservation work in tropical rainforest areas. The studies rate a large fraction of these regions as in a stable conservation status.

c) Examples of country-level priority setting

Environmental policy is largely a national issue. This section presents an example of an explicit environmental priority setting exercise. This seems to be the exception, rather than the rule.

The Chilean Delphi exercise presented above produced a broad list of ranked problems. These have been classified and aggregated at the country level. Table 2 presents the results in terms of frequency of problems identified. In spite of all the limitations of such an approach some interesting issues emerge. The frequency assigned to urban problems clearly overrides the one assigned to natural resource management issues. Industrial issues rate quite low.

The major finding of this review of diverse environmental priority setting exercises is that clearly efforts are focusing mainly on the environmental impacts and only very superficially if at all at the resources needed for the implementation of possible interventions. Thus in terms of contributing to the allocation decisions, they do

help to exclude projects of low potential impact but fall short in terms of prescribing choices among remaining alternatives.

5. Conclusions

a) Environmental priority setting, particularly with reference to research investments is a nascent field. Outputs presently resemble shopping lists, rather than priorities for action.

b) Literature searches and broad consultations through environmental Internet networks (INFOTERRA, SARD, ELAN) were not able to locate applications of economic methods to set priorities among broad environmental research issues. A range of methodological issues need to be resolved such as the rationale for using discounting rates, inter-generational equity issues, before their broader use will become feasible.

c) The lack of information on valuation of natural resources, as well as on elasticities of demand for these, make it difficult to foresee economic surplus models applied to broad, decision-oriented environmental research priority setting exercises in the near future.

d) The above considerations lead to the need to utilize more synthetic, less data-intensive approaches and to emphasize participation as the tool to handle complexity. This does not imply that efforts to document and compare magnitude of environmental/natural resource management issues are not a valuable input to the decision making process.

e) Given IDRC's very limited funding vis a vis the environmental challenges facing the LAC region, investing substantial resources in elaborate procedures may be inefficient vis a vis the value of those resources allocated to an issue ranked important through less elaborate, participatory procedures.

f) Participation seems a key dimension of these post-normal science decisions. For agencies like IDRC dealing with limited funds in a vast and

heterogeneous region, getting the appropriate degree and nature of participation is a challenge.

g) Given the above considerations, the image of a concerted planning effort to allocate resources in different countries and to different issues, similar to the planning of a large multinational company should be replaced by the one of a small entrepreneur identifying a few niches in which he or she decides to play, in close interrelation with key business partners,in a sense moving from a Ptolomean to a Galilean view of real life.

h) If this path is accepted, the corollary may be that one of the interventions with the highest pay-off in the LAC region, is to develop approaches and procedures for "rapid, participatory environmental priority setting" as a tool for environmental decision makers of the region.

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Table 1. Conservation priority ranking for the LAC region

MAJOR HABITAT TYPES (MHTs) / Regional Habitat Units (RHUs) / (COUNTRIES WITHIN WHICH RHUs OCCUR)	Biological Value[1]	Conservation Status[1]	Investment Recommendat[2]
. TROPICAL MOIST FOREST			
-1 **Atlantic** (BRAZIL, ARGENTINA, PARAGUAY)	R	Critical	1
-2 **Upper Amazon** (BRAZIL, COLOMBIA, BOLIVIA, PERU, ECUADOR)	R	Stable	2
-3 **NE Amazon** (BRAZIL, GUYANA)	S	Stable	3
-4 **SE Amazon** (BRAZIL)	L	Vulnerable	3
-5 **Choco-Darien** (COLOMBIA, PANAMA, ECUADOR)	S	Vulnerable	3
-6 **Central American Lowland** (MEXICO to PANAMA)	L	Endangered	3
. TROPICAL MOIST MONTANE			
-1 **Tropical Andes** (VENEZUELA, COLOMBIA, ECU, PERU, BOL, ARG)	R	Endangered	1
-2 **Central Am. Montane** (COSTA RICA, PAN, GUA, HON, SAL, MEX)	S	Vulnerable	2
-3 **Caribbean** (GREATER & LESSER ANTILLES)	S	Vulnerable	3
-4 **Venezuelan Coastal** (VENEZUELA)	L	Vulnerable	3
-5 **Guyana Montane** (VENEZUELA, GUYANA, SURINAME, FR, GUI, BRZ)	S	Intact	3
. TROPICAL DRY FOREST			
-1 **Northern South America Dry** (COLOMBIA, VENEZUELA)	S	Critical	3
-2 **Western Andes** (ECUADOR)	L	Endangered	3
-3 **Chaco** (PARAGUAY, BOLIVIA, ARGENTINA)	R	Vulnerable	2
-4 **Central American Dry** (COSTA RICA, PANAMA, EL SALV, NICAR)	L	Critical	3
-5 **Mexican Dry** (MEXICO, GUATEMALA)	S	Endangered	3
-6 **Cerrado-Pantanal** (BRAZIL, BOLIVIA, PARAGUAY)	R	Endangered	1
. XERIC FORMATIONS			
-1 **Mexican Xerics** (MEXICO, USA)	R	Vulnerable	1[3]
-2 **Caribbean Xerics** (COLOMBIA, VENEZUELA, GRTR & LSSR ANTLLS)	S	Endangered	3
-3 **Caatinga** (BRAZIL)	R	Vulnerable	2
-4 **Peru-Chile Deserts** (PERU, CHILE)	L	Vulnerable	3
-5 **Chilean Winter Rainfall** (CHILE)	S	Endangered	3
-6 **Argentine Monte** (ARGENTINA)	L	Vulnerable	3
. HERBACEOUS LOWLAND GRASSLANDS			
-1 **C.A. Pine Savannah** (NICARAGUA, HONDURAS, BELIZE)	L	Stable	3
-2 **Llanos-Grande Savannah** (VENEZUELA, COLOMBIA)	S	Vulnerable	3
-3 **Pampas** (ARGENTINA, URUGUAY, BRAZIL)	L	Critical	2
-4 **Patagonian Steppe** (ARGENTINA, CHILE)	R	Vulnerable	1
-5 **Amazonian Savannahs** (BRAZIL, PERU, GUYANA, VENEZUELA)	L	Vulnerable	3
. HERBACEOUS MONTANE			
-1 **Paramo** (COLOMBIA, VENEZUELA, PERU, CR, MEX, GUATEM, ECU)	R	Vulnerable	2
-2 **Puna** (PERU, BOLIVIA, ARGENTINA, CHILE)	R	Vulnerable	1[4]
-3 **Southern Andean Alpine** (CHILE, ARGENTINA)	L	Vulnerable	3
-4 **Pantepui** (VENEZUELA, GUYANA)	S	Intact	3
. TEMPERATE FORESTS			
-1 **Southern Temperate Forests** (CHILE, ARGENTINA)	R	Endangered	2
-2 **Brazilian Araucarian** (BRAZIL, ARGENTINA)	S	Critical	3
-3 **Mexican Pine-Oak** (MEXICO)	R	Endangered	1[5]

Biological Value, Conservation Status and Investment Recommendations are ranked within Major Habitat Types.
R = Regionally Outstanding; S = Regionally Significant; L = Locally Important
1 = Highest Priority for Greater Investment; 2 = High Priority for Greater Investment; 3 = Appropriate for Regional and Local Investment
Distinguished from Caatinga on the basis of higher fish biodiversity
Distinguished from Paramo on the basis of higher utility ranking
Distinguished from Southern Temperate Forests on the basis of higher utility ranking

Table 2. Environmental problems by sector, Chile

SECTOR	TOTAL[2]	PERCENTAGE (%)
Urban Planning	229	17.4
Natural Resources Conservation	207	15.8
Urban Services	195	14.9
Industry	99	7.5
Transportation	95	7.2
Health	74	5.6
Agriculture	67	5.1
Mining	53	4.0
Forestry	47	3.6
Road Engineering	46	3.5
Tourism	38	2.9
Irrigation	31	2.4
Fisheries	24	1.8
Sports	23	1.8
Energy	23	1.8
Culture	21	1.6
Animal Production	19	1.4
Trade	11	0.8
Education	6	0.5
Communications	3	0.2
Computer systems	2	0.2
TOTAL	1,313	100.0

source: Espinoza et al, 1994

[2] Total number of identified problems